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Misc Tr
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Condensation of an article by Gausner, G. and W. Straib. 1936

Studies for determination of wheat harvest losses due to yellow and black stem rust infection.

Phytopathologische Zeit-schrift 9:479-505

Most data on yeild losses from rust, especially the older, are based upon estimates whereby the yields in rust years are compared with those of normal years (e.g. 7, 36, 37, 1, 27, 3, 6, 24, 35, 32, etc). How well such estimates can assess the actual losses is questionable because of the influence of other factors.

Bettor criteria for the influence of single estimates were provided by the researches of 14, 19, 20. These authors compared the yields of resistant and susceptible cereal varieties and sought to gain thereby an insight into the significance of rust damage. However the numerical values obtained were still fluctuating and the worth of the correlations obtained appeared to be limited.

Inoculations were made with P. glumarum on 20 and 28 June by spraying with uredospores. On 2 July reinfected individual or isolated plants with cotton swab - first eruption formed on Strubes red Schlanstedter 4 July intensity 2, a weak pustule eruption.

On 21 July intensity of rust was 4-5, on 2 August on leaf blades and sheaths - relatively severe infection intensity 7. Infection corresponded to a severe rust epidemic in stripe rust years.

Von Rumkers Fruher Sommer Dickkopf on 4 July, pustule eruption was somewhat more severe than on Strubes red Schlanstedter - Intensity 3. On 21 July there was considerable infection on blades and sheaths, intensity 6. Distinctly more severe than on the Red. On 2 August intensity 7 on blades and sheaths - identical with the Red.

Janetakis Fruher Sommer Weisen - 4 July 0, 21 July traces but infected plots showed strong yellowish discoloration of leaves. Subsequently only weak pustule eruption intensity 2 1-2. Control plots were initially free. On 21 July three control plots of Strubes Rote Schlanstedter had weak rust for ca 3 meters while plots otherwise remained free of rust up to 2 August. On this day Rote Schlanstedter showed consistent intensity of 2, Von Runkers 2-3 and Janetakis only traces. Weak infection of control plots could not be avoided but this in no way diminished success of the test - Traces of naturally occurring yellow and leaf rust were equally prevalent on control and test plots but so minimal that they could be ignored.

The damage coefficient which we found is designed to help in evaluating the yield depressions formed from rust infection. Generalisations must be made with caution since flustuation intensity as well as local and climatic factors must play a variable role.

Since the years chosen by us were not typical rust years our damage coefficients would not be maximal but should be considered as near the lower limit or normal. Grain losses in Finland 1924-26 are for the most part above our maximal values, but even those are exceeded by data from Argentina from 1930-32 in which up to 2/3 of the normal harvest was lost.

Variety Record

Damage due to yellow and stem rust may be reduced by resistant varieties but it may not be necessary to use varieties highly resistant - the degree of damage among susceptible varieties may fluctuate even when there are no extreme factors of great contrast. In a certain region strongly affected wheat varieties may produce a better yield than more resistant varieties.

Data obtained from national agricultural authorities from variety tests give valuable clues - especially in rust years, however, the evaluation of these tests and determination of true yields is possible only when all test conditions are considered critically.

A deeper understanding of the nature of rust presupposes knowledge of changes in the most important physiological processes brought about in the cereals by rusts. Depression of assimilation has been demonstrated by a number of investigators - see p. 502, (5, 8, 25, 39, 40)

Some of these give quantitatively satisfying data (numerical accuracy). Depression of assimilation of leaves of wheat infected with yellow rust as found by Gassner and Gatse correspond in their order of injury to our damage coefficient. Assimilation does not decrease immediately after infection but when leaf coloration shows first signs of successful infection.

Assimilation is only one, but a very important factor.

There are strong deviations in Nitrogen metabolism of affected leaves, especially a rise in transpiration as reflected in a number of recent studies. Thus there is a variagated picture of corelations between rusts and yield which explains why damage is variable under different external conditions and that differences in varieties are expressed in different ways.

In case of yellow rust we must consider first the influence of normal activity of leaves in case of stem rust on sheaths and stems of maturing cereals we are dealing more or less with disturbances of fluid supply to the heads. For this reason we cannot expect the same extent of damage caused on the same cereal variety by different rusts. Intensity of infection is not only dependent upon total infection but also upon duration.

Percentile depression in yield which rust infection of a certain intensity can exert in one week - thus a moderately severe yellow rust infection during the vegetative development of wheat gave a yield depression of ca 3% for each week - that of a severe yellow rust infection one of 5%. In case of severe stem rust infection these values are even higher. In practice this is less apparent since in our climate stem rust does not become severe until shortly before harvest. On the other hand, with yellow rust, damage will be particularly great if maintained over a large part of the vegetative period in its full severity - e.g. March to July as happened in the rust year of 1926.

SUMMARY

Yellow rust and stem rust were used on varieties of variable susceptibility to determine yield depression in contrast to control plots.

Moderately strong yellow rust for four weeks, end May and June, depressed grain yield by 14% in a susceptible summer variety in 1930. In 1931 three susceptible winter varieties were depressed 11 - 18% by a moderately severe yellow rust attack of four weeks, Mid May - mid June.

In the summer of 1933 grain weight was reduced 25% by severe yellow rust for five weeks. This was Heines Kolben summer wheat. Under the same conditions Oregon wheat variety lost only 14%.

Stem rust tests in 1930 reduced yield by 24% during two weeks of relatively severe infection of Rote Schlanstedter summer wheat. Von Rümkers summer Dickkopf lost 14% under the same conditions.

The damage coefficient in the per cent depression in yield which a certain intensity of rust can cause during one week aside from quantitative losses is considered. Decrease in grain quality was noted for yellow rust and stripe rust.

Rusty wheat has a lower hectaliterweight and per 1000 grain weight and a correspondingly higher sifting percentage.

We get variable yield losses under identical infection intensities according to the wheat variety, especially in case of stem rust. Resistant varieties have smallest relative losses. The tests carried out under completely natural conditions show us the damage inflicted by yellow stem rust in rust years. They also show that losses are quite considerable even in non-rust years at moderately severe yellow rust infections.

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TABLE 1 - Grain and straw yields from yellow rust test with summer wheats in Schlanstedt 1930
(Means of six replicates)

WHEAT VARIETY	Grain yield (kg.) 14% moisture			Z'	Straw yield (kg.)		
	Control plot a	Yellowrust plot b	Difference b-a %		Control plot a	Yellow rust plot b	Difference b-a %
Strubes Red Schlanstedter	2,205$\pm$0,06	1,905$\pm$0,08	- 13,6	3,00	6,28$\pm$0,10	5,31$\pm$0,22	- 15,4
Peragis Summer wheat	2,467$\pm$0,12	2,202$\pm$0,08	- 10,7	1,96	7,14$\pm$0,45	6,36$\pm$0,23	- 10,9
Heines Kolben	1,780$\pm$0,07	1,705$\pm$0,07	- 4,2	0,75	6,72$\pm$0,27	6,97$\pm$0,16	+ 3,7

Oat control

(1) Safety coefficient = $\frac{D}{mD}$

Table 2 - Grain quality in the 1930 Schlanstedt yellow rust test

Wheat variety	Control plot a	Yellow rust plot b	Diff. b-a %	Z	Control plot a	Yellow rust plot b	Diff. b-a %	Z	Control plot a	Yellow rust plot b	Diff. b-a %	Z
Strubes Red Schlanstedter	189±0,8	187±1,2	1.1	1,37	57,0±0,2	55,4±0,5	-2,8	2,97	10,8±0,3	12,0±0,4	+11,1	2,40
Poragis	190±0,7	190±0,6	0	0	58,9±0,4	58,3±0,3	-1,0	1,20	9,4±0,3	9,1±0,3	- 3,2	0,71
Heines Kolben	185±1,1	185±0,9	0	0	51,9±0,8	51,0±0,5	-1,7	0,96	9,4±0,2	10,1±0,3	+ 7,4	1,94

TABLE 3 - Grain yield in winter wheat tests with yellow rust infection at Schlanstedt in 1931. (Average of five plots)

Wheat variety	Control plot a kg	Yellow rust plot b kg	Difference b-a %	z
Ackermanns Bayernkonig	2,23±0,09	1,82±0,04	- 18,4	4,16
Pflugs Baltikum	2,76±0,17	2,45±0,13	- 11,2	1,48
Strubes Dickkopf	2,14±0,07	1,78±0,08	- 16,8	3,39
P. S. G. Hertha	2,68±0,10	2,37±0,04	- 11,6	2,87
Strubes Neuzucht 3186	2,62+0,07	2,25±0,06	14,1	4,02
Carstens Dickkopf V	2,50±0,04	2,29±0,03	- 8,4	4,20
Kraffts Dickkopf	2,30±0,16	2,23±0,07	- 3,0	0,41
Oats control	660 kg/¼/ha	670 kg/¼ ha	+1,5%	

TABLE 4 - Rust behavior in pot tests in the summer of 1933 at Gliesmarode

Rust plot	Yellow Rust races detected	Wheat varieties	Intensity of yellow rust infection
A	Nr. 4	Oregon Heines Kolben	7 Spur
B	Nr. 1 daneben Nr. 4	Oregon Heines Kolben	6 - 7 8
C	Nr. 1	Oregon Heines Kolben	4 - 5 2 - 3

TABLE 5 - Grain- and straw yield in the pot test in the summer of 1933 at Gliesmarode. (Average of 4 pots)

Wheat Variety	Pot	Yellow rust Inf.	Grain Yield g	Grain Yield Diff.		Grain Yield Z	Straw yield g
Oregon	A	7	83,28+2,9	A-C =	- 13,8%	2,02	179,0+3,5
	B	6-7	85,10±1,2	B-C =	- 11,9%	1,87	196,3+7,8
	C	4-5	96,60±6,0	A-B =	- 2,1%	0,58	219,3±4,1
Heines Kolben	A	Spur	106,87+1,9	B-A =	- 25,6%	5,28	293,2+2,4
	B	8	79,60±4,8	B-C =	- 24,1%	4,72	244,5± 7,5
	C	2-3	104,96+2,4	C-A =	- 1,8%	0,62	286,75±4,9

WHEAT VARIETY	Infection Type at a Test Temperature of: 15°	20°
Ackermanns Bavernkonig	IV	IV
Pflugs Baltikum	IV	IV
Strubes Dickkopf	IV	III - IV
P. S. G. Hertha	II - III	0
Strubes Neuzucht 3186	II - III	0
Carstens V	0 +	0
Kraffts Dickkopf	0 +	0

TABLE 6 - Grain and straw yields from stem rust tests with summer wheat in Schlanstedt 19[illegible]0.

Wheat Variety	Grain yield (kg) at 14% moisture				Straw yield (kg)		
	Control plot a	Stem rust plot b	Difference b-a %	Z	Control plot a	Stem rust plot b	Difference b-a %
Strubes Roter S Schlanstedter v.	2,475±0,08	1,880±0,06	-24,0	5,95	7,25±0,18	6,35±0,16	-12,4
Rimpaus Sommer Dickkopf	2,778±0,09	2,290±0,04	-17,6	4,97	6,03±0,12	6,54±0,13	+7,8
Janetzkis Früher Sommer Weizen	1,602±0,04	1,485±0,03	-7,3	2,34	7,71±0,26	7,50±0,18	-2,7
Oats Control	13,2 ±0,26	13,3 ±0,25	+0,8	0,28			

Table 7 - Grain quality in stem rust tests of 1930 at Schlandstedt.

Wheat Variety	Quarter liter weight (g) Control plot a	Stem rust plot b	Diff. b-a %	Δ	1000-kernel weight (g) Control Plot a	Stem rust plot b	Diff b-a %	Δ	% sieve loss (2.5 mm mesh) Control plot a	Stem rust plot b	Diff b-a %	Δ
Strubes Roter Schlanstedter v.	190±0,5	183±0,6	-3,7	8,96	56,7±0,8	45,1±0,1	20,5	9,06	9,2±0,5	19,5±0,7	+112	11,98
Rimkers Sommer Dickkopf	183±0,8	175±0,6	-4,4	8,0	59,6±0,7	51,2±0,6	14,1	9,13	12,5±0,9	13,7±0,8	+9,6	1,0
Janetzkis Fruher Sommer Weizen	181±1,4	176±1,3	-2,8	2,62	43,4±0,5	42,1±0,3	3,0	2,24	15,8±0,9	17,4±0,5	+10,1	1,55

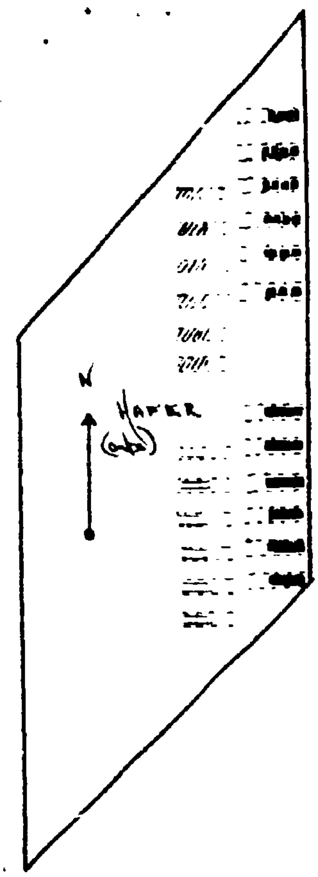

Figure 1: Seeding Order of the 1930

Schlanstedt Rust Test.

Rusted Wheat — Yellow rust test.

Control Wheat Not Infected — Yellow rust test.

Rusted Wheat — Stem rust test.

Control Wheat Not Infected — Stem rust test.

Oats Control

Scale 1 : 4000

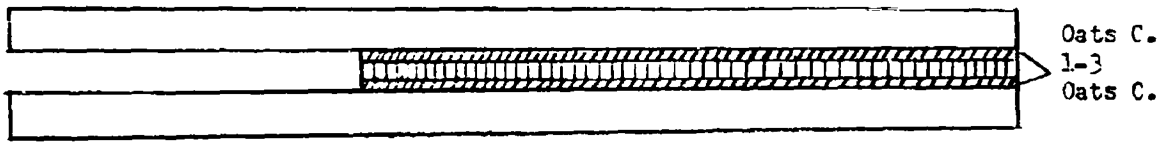

Figure 2: Singe Test Plot Schlanstedt 1930.

1-3 = Wheat Varieties

Oats C. = Oats Control

Scale 1 : 333

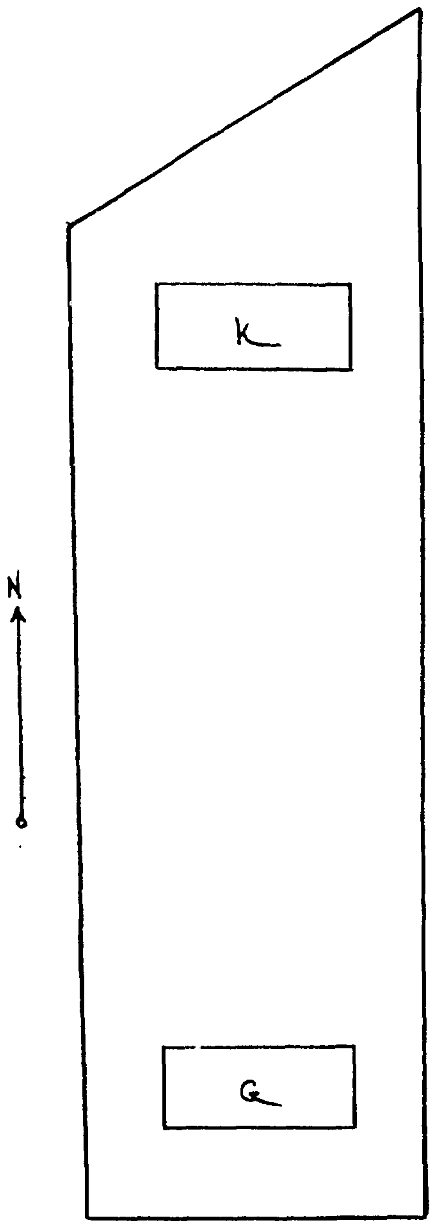

Figure 3 : Arrangement of Wheat Plots In The Rust Test At Schlanstedt 1931.

G = Yellow Rust Plots.

K = Uninnoculated Control Plots.

Scale 1 : 2000

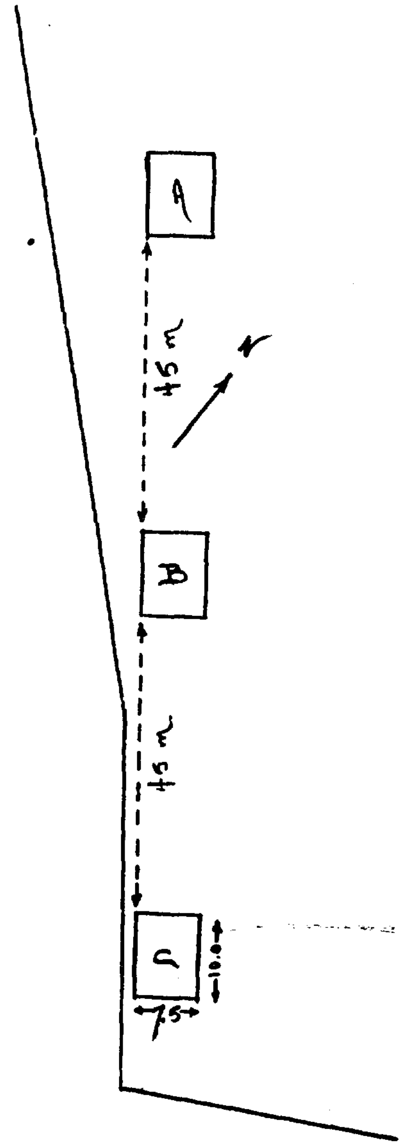

Figure 4: Arrangement of the Rust Plots on the Test Field at Gliesnarode in 1933.

Scale 1:1000